

REPORT DOCUMENTATION PAGE				<i>Form Approved</i> OMB No. 0704-0188	
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1. REPORT DATE (DD-MM-YYYY) 6 Nov 2013		2. REPORT TYPE Consultative Letter		3. DATES COVERED (From – To) 23 July 2013- 1 Nov 2013	
4. TITLE AND SUBTITLE Unshielded and Shielded Facility Nondestructive Inspection (NDI) Radiation Protection Survey for F.S. Gabreski ANGB, NY				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Captain Brian Shuler TSgt Phillip Heil				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) USAF School of Aerospace Medicine Occupational & Environmental Health Dept Consultative Services Division 2510 Fifth St. Wright-Patterson AFB, OH 45433-7913				8. PERFORMING ORGANIZATION REPORT NUMBER AFRL-SA-WP-CL-2013-0023	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSORING/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT Distribution A: Approved for public release; distribution is unlimited. Case Number: 88ABW-2013-4635, 6 Nov 2013					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT The U.S. Air Force School of Aerospace Medicine, Consultative Services Division, Radiation Health Consulting Branch completed an x-ray radiation protection survey. This survey was to evaluate the nondestructive inspection unshielded and shielded facilities for compliance with T.O. 33B-I-I, Chapter 6, <i>Radiographic Inspection Method</i> , and compliance with occupational and general public radiation safety standards. This survey showed compliance with the occupational dose limit of 5 rem/yr and general public radiation dose limit of 100 mrem/yr.					
15. SUBJECT TERMS Nondestructive inspection (NDI), radiation protection survey, unshielded, shielded, F.S. Gabreski ANGB					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT SAR	18. NUMBER OF PAGES 25	19a. NAME OF RESPONSIBLE PERSON Col Mark E. Smallwood
a. REPORT U	b. ABSTRACT U	c. THIS PAGE U			19b. TELEPHONE NUMBER (include area code)



DEPARTMENT OF THE AIR FORCE
USAF SCHOOL OF AEROSPACE MEDICINE (AFMC)
WRIGHT-PATTERSON AFB OH

6 November 2013

MEMORANDUM FOR 106 RQW/MXMFN

ATTN: MSGT JILL BUTLER
FRANCIS S. GABRESKI ANGB
WESTHAMPTON BEACH, NY 11978-1201

FROM: USAFSAM/OEC
2510 FIFTH STREET
WRIGHT-PATTERSON AFB, OH 45433-7913

SUBJECT: Consultative Letter AFRL-SA-WP-CL-2013-0023, Unshielded and Shielded Facility Nondestructive Inspection (NDI) Radiation Protection Survey for F.S. Gabreski ANGB, NY

1. INTRODUCTION:

a. *Purpose:* At the request of the 106 Rescue Wing, Maintenance Squadron, NDI Shop (RQW/MXMFN), the U.S. Air Force School of Aerospace Medicine, Consultative Services Division (USAFSAM/OEC), Radiation Health Consulting Branch completed an x-ray radiation protection survey. The survey was an assessment of the unshielded and shielded NDI facility within building 370. The survey was performed 23-25 July 2013.

b. *Background:* This survey was to evaluate the NDI unshielded and shielded facilities for compliance with T.O. 33B-I-I, Chapter 6, *Radiographic Inspection Method*, and compliance with occupational and general public radiation safety standards. Specifically, this survey included establishing a 2-mrem/h safety perimeter around the unshielded facility to prevent overexposure to the general public and a shielded facility leak test. As part of this survey, an NDI shop operating procedure review to ensure compliance with applicable occupational health and safety regulations to include a review of worker radiation dosimetry and radiation safety training records was completed.

c. *Survey Personnel:*

- (1) Health Physicist, USAFSAM/OEC
- (2) Lead Health Physics Technician, USAFSAM/OEC

d. *Personnel Contacted:*

- (1) Installation Radiation Safety Officer (IRSO), 106 MDG/SGPB
- (2) Certified Radiographer, 106 RQW/MXMFN
- (3) NDI Technician, 106 RQW/MXMFN

e. *NDI Survey Measurement Equipment:*

- (1) Fluke Biomedical – 451P Pressurized Ion Chamber (Serial Number 1444, Calibrated 23 August 2012, Calibration Due 23 August 2013)
- (2) Fluke Biomedical – 451P Pressurized Ion Chamber (Serial Number 4399, Calibrated 05 March 2013, Calibration Due 05 March 2014)
- (3) Fluke Biomedical – 451P Pressurized Ion Chamber (Serial Number 4400, Calibrated 05 March 2013, Calibration Due 05 March 2014)
- (4) Fluke Biomedical – 451P Pressurized Ion Chamber (Serial Number 6573, Calibrated 26 June 2013, Calibration Due 26 June 2014)

2. METHODOLOGY:

a. *Site Layout:* NDI operations are conducted in building 370 on the F.S. Gabreski ANGB flight line ramp as shown in Figure 1. The building is a typical large aircraft hangar that is able to completely enclose a C-130 aircraft. The rear of the hangar has two large retracting doors that run the entire width of the hangar bay. The NDI shop offices are located within this hangar and have a small interior vault for conducting shielded NDI operations.

b. *Unshielded Operations Survey:* During the unshielded NDI operations survey, continuous radiation measurements were taken around the perimeter of building 370 to establish the 2-mrem/h line for various x-ray tubehead configurations. For each series of x-ray exposures there are multiple x-ray shots. Tubehead configurations included the front crew door and four separate configurations for the interior aircraft structural support tube attach fittings in the rear of the aircraft. For each series of x-rays, the x-ray tube was configured to simulate a worst-case exposure level. The x-ray tube (Lorad LPX-160) power was set to 80 kVp and 5 mA when inspecting the front crew door and set to 130 kVp and 4 mA when inspecting the tube attach fittings. Attachment 1 shows a diagram of x-ray tube head placement and shot direction.

c. *Shielded Operations Survey:* Shielded NDI operations are conducted in a small interior vault located within the NDI office in hangar “A.” Measurements were taken around the entire exterior of this vault to ensure that no x-ray scatter escapes during operations. A representative piece of metal was used during shielded operations to simulate an aircraft part, as no operational aircraft part was available during this period. The same Lorad LPX-160 was used with the power set to 160 kVp and 5 mA to represent the maximum settings that would ever be used within the shielded facility.



Figure 1. Overhead View of NDI Facility and Survey Area

d. *General Radiation Safety Review:* General radiation safety protocols were reviewed using the checklist in Attachments 2 and 3 that is based upon T.O. 33B-1-1, 10 CFR 20, and AFMAN 48-125, *Personnel Ionizing Radiation Dosimetry*.

- (1) Verify unshielded/shielded NDI safety procedures meet T.O. 33B-1-1 and other occupational safety and health requirements.
- (2) Verify an adequate number of personal monitoring devices were available and operational and observed personnel were correctly wearing these devices while performing NDI operations.
- (3) Verify all radiation exclusion/controlled areas were properly established as required by T.O. 33B-1-1, ensuring controlled radiation area was cordoned off with cones and rope barriers marked with appropriate signage as required by T.O. 33B-1-1.
- (4) Verify x-ray shot and personal radiation dosimetry logs were properly completed.

3. RESULTS:

a. *Unshielded Operations Survey:* The radiation survey established a new recommended controlled area line during unshielded NDI operations as shown in Figure 2. The new recommended controlled area extends southeast from building 370 approximately 245 feet onto

the tarmac and is a width equal to building 370. The controlled area is taken to be the exterior walls of the building on the north, east, and west sides. Table 1 shows the maximum estimated workload summary for unshielded operations, and Table 2 shows the survey measurements and estimated dose rate for unshielded operations. This survey showed compliance with the occupational dose limit of 5 rem/yr and general public radiation dose limit of 100 mrem/yr.

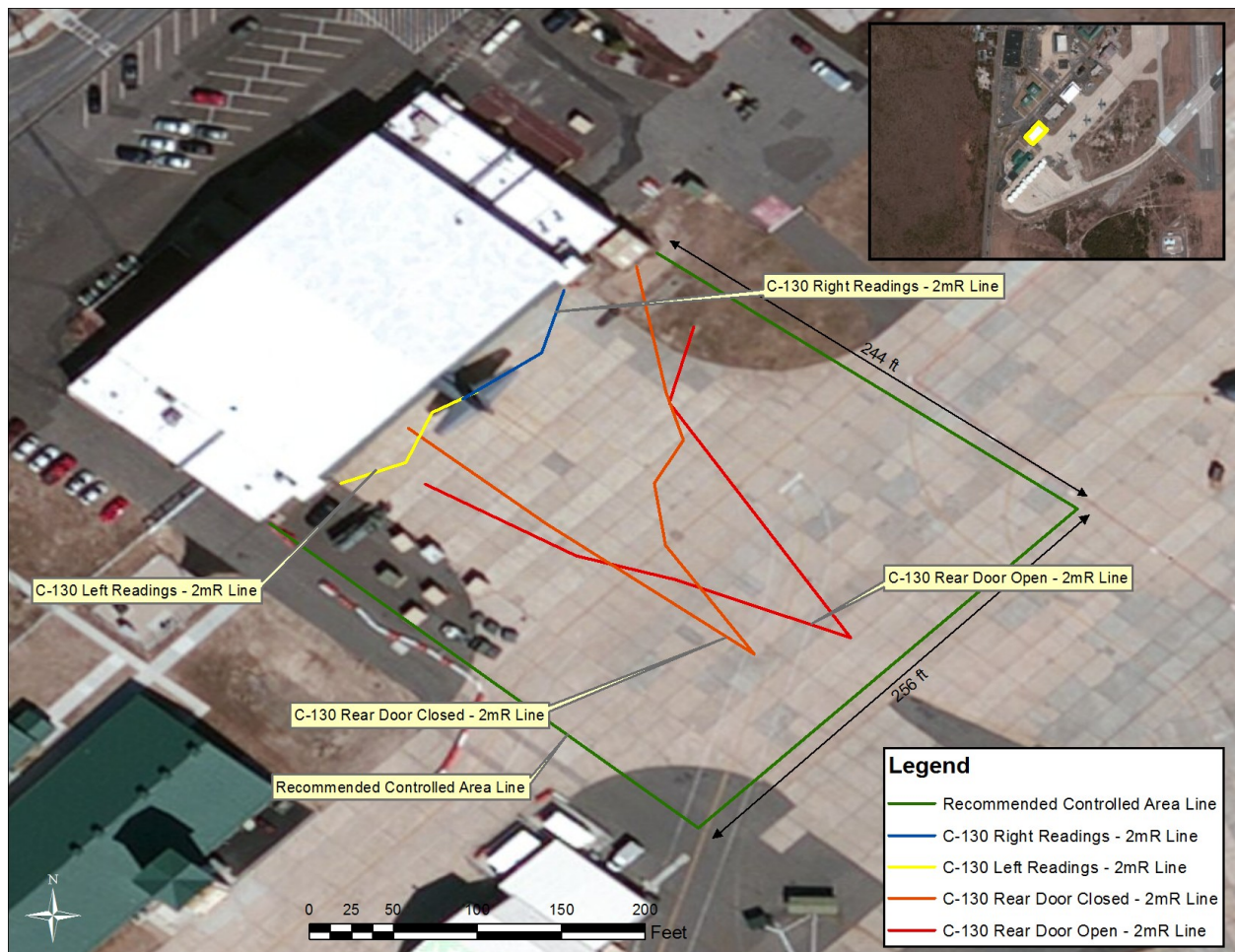


Figure 2. Gabreski ANG Base Unshielded NDI Survey Map

b. *Shielded Operations Survey:* The shielded NDI operations survey showed there was no hazard to personnel outside of the vault. Table 3 shows the maximum estimated workload summary for shielded operations, and Table 4 shows the survey measurements and estimated dose rate for shielded operations.

Table 1. Unshielded NDI Operations Maximum Estimated Workload Summary

Exposure Type	Technique			Exposures per Year	Estimated Beam On Time (h/yr) ^b
	kVp	mA	Min ^a		
Average AFTO 125 Documented Settings	113	5	7	17	2

^aMaximum exposure time (min), assumed for this worst-case calculation.

^bEstimated Beam On Time (h/yr) = [maximum exposure time (min)] x (exposures per year) / (60 min/h).

Table 2. Unshielded Survey Measurements and Dose Rate Estimated

Diagram Location/Description	451P Bkg Reading (mR/h)	Area ^a	Highest Reading (mR/h)	Net Reading (mR/h)	Occupancy Factor	Max Est. 1-h Dose (mrem) ^b	Max Est. 1-yr Dose (mrem) ^c	Exceeds 2 mrem in any 1 h?	Exceeds 100 mrem/yr?
Operator's location (inside shielded NDI vault)/ chest height	0.009	C	0.009	0.0	1	0.0	0.0	No	No
Roll-up door on contact/ chest height	0.009	C	2.0	1.9	1	1.9	3.8	No	No
Parking lot - 30 ft out from center of roll-up door/chest height	0.009	C	0.05	0.041	1	0.0	0.1	No	No
2 mR line/ chest height	0.009	C	2.0	1.9	1	1.9	3.8	No	No

^aArea: C, Controlled Area; an area controlled by the NDI section and where workers have completed ALARA training.

^bMax Dose Estimate for 1 h = (Net Reading in mR/h) * [Exposure Duration (h)].

^cAnnual Dose Estimate = (Net Reading (mR/h) * (Occupancy Factor) * (Total estimated beam on time in h/yr)). It was assumed that 1 mR/h = 1 mrem/h.

Table 3. Shielded NDI Operations Maximum Estimated Workload Summary

Exposure Type	Technique			Exposures per Year	Estimated Beam On Time (h/yr) ^b
	kVp	mA	Min ^a		
Average AFTO 125 Documented Settings	160	5	7	2	0.23

^aMaximum exposure time (min), assumed for this worst-case calculation.

^bEstimated Beam On Time (h/yr) = [maximum exposure time (min)] x (exposures per year) / (60 min/h).

Table 4. Shielded Survey Measurements and Dose Rate Estimated

Diagram Location/Description	451P Bkg Reading (mR/h)	Area ^a	Highest Reading (mR/h)	Net Reading (mR/h)	Occupancy Factor	Max Est. 1-h Dose (mrem) ^b	Max Est. 1-yr Dose (mrem) ^c	Exceeds 2 mrem in any 1 h?	Exceeds 100 mrem/yr?
Operator's location (outside shielded NDI vault)/ chest height	0.009	C	0.009	0.0	1	0.0	0.0	No	No
Outside of shielded NDI vault along seam of doors/ various locations	0.009	C	0.045	0.04	1	0.01	0.01	No	No

^aArea: C, Controlled Area; an area controlled by the NDI section and where workers have completed ALARA training.

^bMax Dose Estimate for 1 h = (Net Reading in mR/h)*[Exposure Duration (h)].

^cAnnual Dose Estimate = (Net Reading (mR/h)*(Occupancy Factor)*(Total estimated beam on time in h/yr). It was assumed that 1 mR/h = 1 mrem/h.

c. A general radiation safety review resulted in the following observations:

- (1) Unshielded/shielded NDI safety procedures meet occupational safety and health requirements as specified within T.O 33B-1-1, 10 CFR 20, and AFMAN 48-125.
- (2) An adequate number of personal radiation monitoring devices were available and operational. Personnel were observed correctly wearing these devices while performing NDI operations.
- (3) Procedures establishing the unshielded NDI operations exclusion/controlled areas were properly implemented.

- (4) Controlled areas exhibited proper visual/audible warnings and radiation warning signs. Barrier ropes around the exclusion/controlled area were not used. Interlocks preventing activation unless a warning light was connected was observed to be functioning.
- (5) At least two serviceable, properly calibrated radiation survey meters were in use by NDI personnel. In addition, at least one qualified radiographer was present during all operations.

4. DISCUSSION: The workplace Industrial Radiography Utilization Log, AFTO IMT 125, contains eight blocks from which different monitoring positions and the associated maximum observed dose rate can be annotated. While it was noted that NDI shop personnel correctly used their radiation survey meters, the peak levels were not recorded onto the AFTO IMT 125 for these surveys. USAFSAM personnel conducting the radiation survey took radiation measurements in the same locations as the NDI shop and did not find anything significant to report.

5. CONCLUSIONS AND RECOMMENDATIONS:

- a. This survey showed compliance with the occupational dose limit of 5 rem/yr and general public radiation dose limit of 100 mrem/yr.
- b. During unshielded operations, the NDI shop must completely secure the recommended restricted area (Figure 2) by using rope barriers, cones, and signage and ensure no unauthorized personnel are inside building 370. Refer to T.O. 33B-1-1, Para 6.8.8.2 for guidance.
- c. Additional qualified radiographers or radiation safety monitor assistants should be used to maintain visibility with the exclusion/controlled areas. This requirement is spelled out in section 6.8.8.2.5, paragraph a, of T.O 33B-1-1.
- d. The NDI shop should ensure that Industrial Radiography Utilization Logs (AFTO IMT 125) are accurately filled out.
- e. To avoid speculation or uncertainty regarding the specific monitoring locations and the associated maximum dose rate on the AFTO IMT 125, detailed descriptions of each monitoring position should be documented and reviewed by all personnel prior to performing radiography work.
- f. The offices responsible for flight line operations as well as the offices near building 370 should be informed of unshielded NDI operations taking place to prevent unauthorized personnel from breaching the restricted area.
- g. Recommend that NDI personnel get electronic personal dosimeters that allow them to set alarm rates as well as see their cumulative radiation dose in real time.

h. Any changes to NDI operations or to the location where operations are performed will require revalidation by qualified personnel.

6. If you have any questions regarding this report, please contact the ESOH Service Center at 1-888-232-3764, DSN 798-3764.

A handwritten signature in black ink, reading "Brian D. Shuler". The signature is fluid and cursive, with a horizontal line extending from the end of the name.

BRIAN D. SHULER, Capt, USAF, BSC
Chief, Radiation Health Consulting Branch












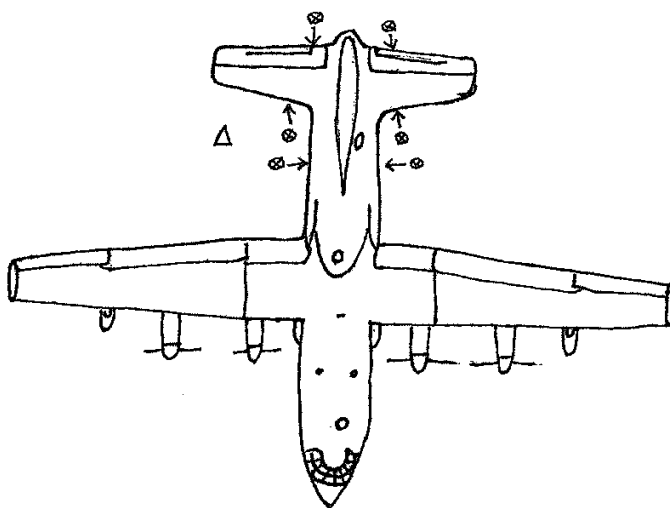
4 Attachments:

1. Unshielded NDI X-Ray Locations
2. Unshielded Nondestructive Inspection Survey Form
3. Shielded Nondestructive Inspection Survey Form
4. Instrument Calibration Sheets

Attachment 1 UNSHIELDED NDI X-RAY LOCATIONS

INDUSTRIAL RADIOGRAPHY UTILIZATION LOG FACILITY SURVEY DRAWING	
ORGANIZATION 106 MXS/MXMMEN FS. GABRESKI ARPT, WNB, NY	RSO SURVEY DATE 24 JULY 2013
AIRCRAFT MODEL HC-130 N/P	PART NOMENCLATURE CREW DOOR
DETAILED DRAWING OF EXPOSURE AREA	
LEGEND <div style="display: flex; flex-direction: column; gap: 5px;"> <div> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; width: 15px; height: 15px; margin-right: 5px; text-align: center; line-height: 15px;">↑</div> <div>TUBEHEAD WITH BEAM AIMED UP (Ceiling/Sky)</div> </div> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; width: 15px; height: 15px; margin-right: 5px; text-align: center; line-height: 15px;">↓</div> <div>TUBEHEAD WITH BEAM AIMED DOWN (Floor/Ground)</div> </div> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; width: 15px; height: 15px; margin-right: 5px; text-align: center; line-height: 15px;">←</div> <div>TUBEHEAD WITH BEAM WEST OR LEFT (Cockpit View)</div> </div> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; width: 15px; height: 15px; margin-right: 5px; text-align: center; line-height: 15px;">→</div> <div>TUBEHEAD WITH BEAM EAST OR RIGHT (Cockpit View)</div> </div> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; width: 15px; height: 15px; margin-right: 5px; text-align: center; line-height: 15px;">↑</div> <div>TUBEHEAD WITH BEAM NORTH OR FORWARD (Cockpit View)</div> </div> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; width: 15px; height: 15px; margin-right: 5px; text-align: center; line-height: 15px;">↓</div> <div>TUBEHEAD WITH BEAM SOUTH OR AFT (Cockpit View)</div> </div> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; width: 15px; height: 15px; margin-right: 5px; text-align: center; line-height: 15px;">X</div> <div>X-RAY CONTROL BOX LOCATION</div> </div> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; width: 15px; height: 15px; margin-right: 5px; text-align: center; line-height: 15px;">1</div> <div>RADIOGRAPHER IN CHARGE MONITORING POSITION (Near Control Box)</div> </div> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; width: 15px; height: 15px; margin-right: 5px; text-align: center; line-height: 15px;">2 thru 1</div> <div>RADIOGRAPHY MONITORS/ASSISTANTS MONITORING POSITIONS</div> </div> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; width: 15px; height: 15px; margin-right: 5px; text-align: center; line-height: 15px;">△</div> <div>RADIATION WARNING BEACONS</div> </div> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; width: 15px; height: 15px; margin-right: 5px; text-align: center; line-height: 15px;">*****</div> <div>2 mR/hr BARRIER</div> </div> </div> </div>	
SUPERVISOR REVIEW	
DATE 24 JULY 2013	PRINTED NAME/GRADE: BUTLER, JILL MSgt
DATE	PRINTED NAME/GRADE:
SIGNATURE Jill Butler	
SIGNATURE	

AFTO IMT 125A, 20051130, V-1

INDUSTRIAL RADIOGRAPHY UTILIZATION LOG FACILITY SURVEY DRAWING										
ORGANIZATION: 100 MXS/MXMFN	RSO SURVEY DATE: 24 JULY 2013									
F.S. GABRESKI APT, WMB, NY	AIRCRAFT MODEL: HC-130 N/P									
PART NOMENCLATURE: TUBE ATTACH FITTING										
DETAILED DRAWING OF EXPOSURE AREA										
LEGEND <div style="display: flex; flex-direction: column; gap: 5px;"> <div> TUBEHEAD WITH BEAM AIMED UP (Ceiling/Sky)</div> <div> TUBEHEAD WITH BEAM AIMED DOWN (Floor/Ground)</div> <div> TUBEHEAD WITH BEAM WEST OR LEFT (Cockpit View)</div> <div> TUBEHEAD WITH BEAM EAST OR RIGHT (Cockpit View)</div> <div> TUBEHEAD WITH BEAM NORTH OR FORWARD (Cockpit View)</div> <div> TUBEHEAD WITH BEAM SOUTH OR AFT (Cockpit View)</div> <div> X-RAY CONTROL BOX LOCATION</div> <div> RADIOGRAPHER IN CHARGE MONITORING POSITION (Near Control Box)</div> <div> RADIOGRAPHY MONITORS/ASSISTANTS MONITORING POSITIONS</div> <div> RADIATION WARNING BEACONS</div> <div> 2 mR/hr BARRIER</div> </div>										
<table border="1" style="width: 100%;"> <tr> <td>DATE: 24 JULY 2013</td> <td>PRINTED NAME/GRADE: BUTLER, JILL MSgt</td> <td>SUPERVISOR REVIEW</td> </tr> <tr> <td>DATE:</td> <td>PRINTED NAME/GRADE:</td> <td>SIGNATURE: <i>Jill Butler</i></td> </tr> <tr> <td colspan="2"></td> <td>SIGNATURE:</td> </tr> </table>		DATE: 24 JULY 2013	PRINTED NAME/GRADE: BUTLER, JILL MSgt	SUPERVISOR REVIEW	DATE:	PRINTED NAME/GRADE:	SIGNATURE: <i>Jill Butler</i>			SIGNATURE:
DATE: 24 JULY 2013	PRINTED NAME/GRADE: BUTLER, JILL MSgt	SUPERVISOR REVIEW								
DATE:	PRINTED NAME/GRADE:	SIGNATURE: <i>Jill Butler</i>								
		SIGNATURE:								

AFTO IMT 125A, 20051130, V-1

Attachment 2
UNSHIELDED NONDESTRUCTIVE INSPECTION SURVEY FORM

Survey Performed By: USAFSAM/OEC
Radiation Health Consulting Branch

Survey Date: 24 Jul 13

I. FACILITY IDENTIFICATION:

A. Base: Gabreski ANGB

B. Bldg Number: 370, Hangar A

C. State/Country: NY, USA

D. Room Number: N/A

E. Command: ANG

F. Phone Number (DSN): 456-7530

G. Organization: 106 RQW/MXMFN

H. WPI:

II. PERSONNEL:

TITLE

Shop Chief, NDI
NDI Technician

ROLE/RESPONSIBILITY

Radiographer in Charge (RIC)
Radiation Safety Monitor

III. EQUIPMENT IDENTIFICATION:

Manufacturer / Model Number	Serial Number	Maximum kVp	Maximum mA
LORAD / LPX-160	CO595243 (Console) 13207960527 (X-Ray Tube)	130	4

IV. DOSE ASSESSMENT AND PERSONNEL MONITORING:

YES NO N/A

A. Persons adequately monitored (10 CFR 20.1502; T.O. 33B-1-1, 6.8.5.3)

☒ ☐ ☐

B. Thermoluminescent device available

☒ ☐ ☐

1. One per radiographer

☒ ☐ ☐

2. Worn during radiography

☒ ☐ ☐

3. TLDs properly stored (AFMAN 48-125; T.O. 33B-1-1, 6.8.5.4.4)

☒ ☐ ☐

4. TLDs returned to storage rack at the end of the work day

☒ ☐ ☐

5. TLD exchange frequency:

Quarterly

6. TLD review period:

Quarterly

C. Pocket ionization chamber (PIC) or electronic personal dosimeter (EPD) available

☒ ☐ ☐

1. Proper central storage location for PIC/EPDs and control

☒ ☐ ☐

2. Date of last usage

23 Jul 13

3. Quantity of dosimeters on-hand:

4

Quantity at PMEL:

0

	YES	NO	N/A
4. Sufficient number on-hand	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Worn during radiography	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Calibration interval	Annual		
Calibration of all on-hand current	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. All function properly	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. EPD audible alarm checked prior to each work day	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
9. EPD audible alarm set at dose <500 mR	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
10. Utilization log available (T.O. 33B-1-1, 6.3.10.2.1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Readings recorded daily (unshielded operations)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Date of last entry:	23 Jul 13		
12. Real-time dosimeter log maintained for 3 years	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
13. Exposures within limits (10 CFR 20.120; T.O. 33B-1-1, 6.8.5.2.1.1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Prior cumulative occupational doses obtained/attempted (10 CFR 20.210)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Exposure data supplied to workers annually (10 CFR 19.13)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

V. Standard Operating Procedures:

	YES	NO	N/A
1. Procedures clearly define radiation exclusion/controlled areas	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
a. Areas properly established and adequately controlled	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b. Audible warnings	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Visible warnings	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Interlocks	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Delay switches	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Emergency shut-off (ESO) switches	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. Restricted areas roped off to control access during irradiation operations	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
h. Safety monitors designated to control restricted areas where other controls are not practical	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Doses in controlled areas and environments meet general public limits (T.O. 33B-1-1, 6.8.8.2.4b)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. At least two individuals to include one qualified radiographer are in attendance during all radiographic operations	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. At least two serviceable, properly calibrated radiation survey meters are in use during unshielded ops	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Restrict use of X-radiography equipment to qualified radiographers	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Clearly define emergency procedures	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Clearly define responsibilities and actions to be taken to investigate overexposures to radiation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Mandate recording of records of radiation surveys to document that radiation safety surveys are actually being performed prior to each radiography operation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Ensure that x-ray equipment is adequately secured when not in use to preclude unauthorized use	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Attachment 3
SHIELDED NONDESTRUCTIVE INSPECTION SURVEY FORM

Survey Performed By: USAFSAM/OEC
 Radiation Health Consulting Branch

Survey Date: 23 Jul 13

I. FACILITY IDENTIFICATION:

A. Base: Gabreski ANGB

B. Bldg Number: 370, Hangar A

C. State/Country: NY, USA

D. Room Number: N/A

E. Command: ANG

F. Phone Number (DSN): 456-7530

G. Organization: 106 RQW/MXMFN

H. WPI:

II. PERSONNEL:

TITLE

Shop Chief, NDI
 NDI Technician

ROLE/RESPONSIBILITY

Radiographer in Charge (RIC)
 Radiation Safety Monitor

III. EQUIPMENT IDENTIFICATION:

Manufacturer / Model Number	Serial Number	Maximum kVp	Maximum mA
LORAD / LPX-160	CO595243 (Console) 13207960527 (X-Ray Tube)	160	5

IV. DOSE ASSESSMENT AND PERSONNEL MONITORING:

YES NO N/A

A. Persons adequately monitored (10 CFR 20.1502; T.O. 33B-1-1, 6.8.5.3)

☒ ☐ ☐

B. Thermoluminescent device available

☒ ☐ ☐

1. One per radiographer

☒ ☐ ☐

2. Worn during radiography

☒ ☐ ☐

3. TLDs properly stored (AFMAN 48-125; T.O. 33B-1-1, 6.8.5.4.4)

☒ ☐ ☐

4. TLDs returned to storage rack at the end of the work day
 (T.O. 33B-1-1, 6.8.5.4.4)

☒ ☐ ☐

5. TLD exchange frequency:

Quarterly

6. TLD review period:

Quarterly

C. Pocket ionization chamber (PIC) or electronic personal dosimeter (EPD)

Available

☒ ☐ ☐

1. Proper central storage location for PIC/EPDs and control

☒ ☐ ☐

2. Date of last usage:

23 Jul 13

3. Quantity of dosimeters on-hand:

04

Quantity at PMEL:

	0		
4. Sufficient number on-hand	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Worn during radiography	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Calibration interval	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
a. Interval not greater than 360 days	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Calibration of all on-hand current	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. All function properly	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. EPD audible alarm checked prior to each work day	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
9. EPD audible alarm set at dose rate <500 mR/h	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
10. Utilization log available (T.O. 33B-1-1, 6.3.10.2.1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Readings recorded daily (unshielded operations)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Date of last entry:			
12. Real-time dosimeter log maintained for 3 years	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
13. Exposures within limits (10 CFR 20.120; T.O. 33B-1-1, 6.8.5.2.1.1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Prior cumulative occupational doses obtained/attempted (10 CFR 20.2104)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Exposure data supplied to workers annually (10 CFR 19.13)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

VII. EXPOSURE AREA DESCRIPTION:

1. Installation inspected each day facility used (T.O. 33B-1-1, 6.8.8.1.c)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
a. AFTO Form 135 utilized	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Audible warnings	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Visible warnings	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Interlocks	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Delay switches	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Emergency shut-off (ESO) switches	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Doses in controlled areas and environments meet general public limits (T.O. 33B-1-1, 6.8.8.1.a)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Suitable means of exit when doors are closed (T.O. 33B-1-1, 6.8.16.2)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Exposure room uncluttered and not used for excessive storage (T.O. 33B-1-1, 6.8.7.2.1.3)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Each personnel entry has available (T.O. 33B-1-1, 6.8.7.2.1.3)			
a. Audible warning signal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Ceases when exposure is started	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ii. Activated at least 20 s prior to exposure	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Visible signal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Inside exposure room type and color: <u>Red Rotating Beacon</u>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ii. Outside exposure room type and color: <u>Red Rotating Beacon</u>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
iii. Activated at least 20 s prior to exposure	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
iv. Remain actuated during exposure	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Pre-start switch located inside enclosure and operational. Not required if tubehead is de-energized when interlock is tripped, and tubehead cannot be re-energized by merely closing interlock ... entire time delay interlock system must be re-initiated at control panel.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
a. Type: <u>amber beacon warning system 20 seconds before exposure</u>			
b. Pre-start activated before first exposure	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Reset required if interlocked tripped	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Reset required if ESO pressed	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Functions properly	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Located inside exposure room	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- | | | | |
|--|-------------------------------------|--------------------------|-------------------------------------|
| 7. Interlock system on each personnel access (T.O. 33B-1-1, 6.8.7.3.4) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| a. Type of interlock system used: | | Dual | |
| b. Tube head is de-energized when interlock is tripped | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c. X-ray tube cannot re-energize by closing interlock | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d. Interlock system tested at least every 6 months – unshielded installation | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 8. ESO switch within facility (T.O. 33B-1-1, 6.8.16.2) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| a. Type: | | Push-In | Red Button |
| b. Number: | | 4 | |
| c. Function properly | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d. Readily accessible | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e. ESO properly identified by labeling | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| f. Suitable means to exit so person inside enclosure may exit without delay | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Areas properly posted with applicable warning signs (T.O. 33B-1-1, 6.8.16.2) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| a. Inside exposure room: “ <u>Caution, High Radiation Area</u> ” | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b. Entrances to exposure room: “ <u>Caution, Radiation Area</u> ” | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Qualified radiographer present at control panel during exposures (T.O. 33B-1-1, 6.8.8.1) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. Safety switch key removed when exposure is completed (T.O. 33B-1-1, 6.8.8.1) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. Search for personnel performed prior to activation (T.O. 33B-1-1, 6.8.8.1) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

VIII. SAFETY CHECK

YES NO N/A

A. Operating Instructions

- | | | | |
|---|-------------------------------------|--------------------------|--------------------------|
| 1. Radiological safety operating and emergency procedures approved by RSO (T.O. 33B-1-1, 6.8.2.2.2.4) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| a. Date of review: | | 15 May 13 | |
| b. Emergency procedures specify: | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| i. Suspected overexposure contact info | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ii. Forms to be completed | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| iii. Individual treatment locations | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| iv. Approximating degree of exposure | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| v. Direct reading dosimeters/TLDs | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Base RSO provided ALARA training (T.O. 33B-1-1, 6.8.2.1) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Ensure personnel are removed during exposures | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Survey meter used during entries into controlled areas after exposure | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Exposures assessed in controlled/uncontrolled areas (T.O. 33B-1-1, 6.8.5.7.5.3) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Written reports filed with appropriate agencies (T.O. 33B-1-1, 6.8.5.7.5.1) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Written reports contain specified/required elements (T.O. 33B-1-1, 6.8.5.7.5.3) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

B. Radiographers:

- | | | | |
|--|-------------------------------------|--------------------------|--------------------------|
| 1. Radiographers qualified through AF NDI Course (T.O. 33B-1-1, 6.8.3.1) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Job/qualifications filed in AF Form 623 (T.O. 33B-1-1, 6.8.3.2) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Initial training (T.O. 33B-1-1, 6.8.4.1) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Attachment 4
INSTRUMENT CALIBRATION SHEETS

AIR FORCE PRIMARY STANDARDS LABORATORY

CERTIFICATE OF CALIBRATION

Report Number: 122340040 **Department:** Photonics/Nucleonics **Date of Issue:** 20120823

Calibration Item:

Manufacturer: FLUKE BIOMEDICAL
Model/Part No.: 451P SERIES
Equipment Type: ION CHAMBER SURVEY METER

Equipment Submitted by:

88 MSG/LGRMD
5060 PEARSON ROAD
WRIGHT PATTERSON AFB, OH, 45433-5517

Serial Number: 0000001444
ID Number: F158810

Item Condition:

As Received: IN-TOLERANCE

The measured values of all parameters tested or calibrated were found to be within specification limits.

As Returned: IN-TOLERANCE

Item was calibrated and returned in-tolerance. This includes TO directed limitations.

Room Ambient Conditions:

Temperature: 72.48 °F Relative Humidity: 47.8 % Barometric Pressure: N/A

Remarks:

Traceability: Measurement standards and test equipment used are traceable to the International System of Units (SI) through the National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facilities; or to other National Metrology Institutes (NMI); or have been derived from accepted values of natural physical constants; or mutual consent standards; or have been derived by the ratio or reciprocity type measurement techniques.

General Conditions:

1. The standards and calibration program of the AFPSL, as operated by The Bionetics Corporation, Newark Metrology Operations, complies with the requirements of the current version of ISO/IEC 17025 on the date of calibration.
2. This report may not be reproduced, except in full, without written approval of The Bionetics Corporation, Newark Metrology Operations.

Calibrated By:

Mark Cooperrider **Metrology Technician**



Approved By:

Donald M. Hayes **Lead Metrology Technician**



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813 Irving-Wick Drive West, Heath, Ohio 43056-6118 TEL: (740) 788-5400 FAX: (740) 788-5404

Report Number: 122340040
Date of Issue: 20120823
Model/Part No.: 451P SERIES
Serial Number: 0000001444

Procedures and Equipment Used

PROCEDURES

Procedure
33K7-4-93-1

Date
30 Nov 2003

EQUIPMENT

Nomenclature
CESIUM-137 STANDARD

Model/Part No.
81-10

ID No.
P71065

NIST Report No.
N/A

Cal Due Date
20140519

The reported value(s) and uncertainties resulting from the measurement process are:

Report of Measurement

Range mR/hr	Applied mR/hr	T.I. Reading mR/hr
0 - 0.5	0.4	0.404
0 - 5	1.0	1.01
0 - 5	4.0	4.04
0 - 50	10.0	10.0
0 - 50	40.0	39.7
0 - 500	100	100
0 - 500	400	395
R/hr	R/hr	R/hr
0 - 5	1.0	0.95
0 - 5	4.0	4.07

- The instrument calibration results are accurate to within $\pm 10\%$ of reading between 10 and 100% full scale on any range, exclusive of energy response.



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451P

AIR FORCE PRIMARY STANDARDS LABORATORY

CERTIFICATE OF CALIBRATION

Report Number: 130630079 Department: Photonics/Nucleonics Date of Issue: 20130305

Calibration Item:

Manufacturer: FLUKE BIOMEDICAL
Model/Part No.: 451P SERIES
Equipment Type: ION CHAMBER SURVEY METER

Equipment Submitted by:

88 MSG/LGRMD
5060 PEARSON ROAD
WRIGHT PATTERSON AFB, OH, 45433-5517

Serial Number: 0000004399
ID Number: M108386

Item Condition:

As Received: IN-TOLERANCE

The measured values of all parameters tested or calibrated were found to be within specification limits.

As Returned: IN-TOLERANCE

Item was calibrated and returned in-tolerance. This includes TO directed limitations.

Room Ambient Conditions:

Temperature: 73 °F

Relative Humidity: 35 %

Barometric Pressure: N/A

Remarks:

Traceability: Measurement standards and test equipment used are traceable to the International System of Units (SI) through the National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facilities; or to other National Metrology Institutes (NMI); or have been derived from accepted values of natural physical constants; or mutual consent standards; or have been derived by the ratio or reciprocity type measurement techniques.

General Conditions:

1. The standards and calibration program of the AFPSL, as operated by The Bionetics Corporation, Newark Metrology Operations, complies with the requirements of the current version of ISO/IEC 17025 on the date of calibration.
2. This report may not be reproduced, except in full, without written approval of The Bionetics Corporation, Newark Metrology Operations.

Calibrated By:

Chris Morris Metrology Technician



Approved By:

Curtis A. Brissette Metrology Technician



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Report Number: 130630079
Date of Issue: 20130305
Model/Part No.: 451P SERIES
Serial Number: 0000004399

Procedures and Equipment Used

PROCEDURES

Procedure
33K7-4-93-1

Date
30 Nov 2003

EQUIPMENT

Nomenclature
CESIUM-137 STANDARD

Model/Part No.
81-10

ID No.
P71065

NIST Report No.
N/A

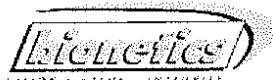
Cal Due Date
20130927

The reported value(s) and uncertainties resulting from the measurement process are:

Report of Measurement

Range mR/hr	Applied mR/hr	T.I. Reading mR/hr
0 - 0.5	0.4	0.405
0 - 5	1.0	0.98
0 - 5	4.0	3.93
0 - 50	10.0	9.5
0 - 50	40.0	37.1
0 - 500	100	95
0 - 500	400	371
R/hr	R/hr	R/hr
0 - 5	1.0	0.99
0 - 5	4.0	4.19

- The instrument calibration results are accurate to within $\pm 10\%$ of reading between 10 and 100% full scale on any range, exclusive of energy response.



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451P

AIR FORCE PRIMARY STANDARDS LABORATORY
CERTIFICATE OF CALIBRATION

Report Number: 130630070 **Department:** Photonics/Nucleonics **Date of Issue:** 20130305

Calibration Item:

Manufacturer: FLUKE BIOMEDICAL
Model/Part No.: 451P SERIES
Equipment Type: ION CHAMBER SURVEY METER

Equipment Submitted by:

88 MSG/LGRMD
5060 PEARSON ROAD
WRIGHT PATTERSON AFB, OH, 45433-5517

Serial Number: 0000004400
ID Number: F148456

Item Condition:

As Received: IN-TOLERANCE

The measured values of all parameters tested or calibrated were found to be within specification limits.

As Returned: IN-TOLERANCE

Item was calibrated and returned in-tolerance. This includes TO directed limitations.

Room Ambient Conditions:

Temperature: 72 °F

Relative Humidity: 36 %

Barometric Pressure: N/A

Remarks:

Traceability: Measurement standards and test equipment used are traceable to the International System of Units (SI) through the National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facilities; or to other National Metrology Institutes (NMI); or have been derived from accepted values of natural physical constants; or mutual consent standards; or have been derived by the ratio or reciprocity type measurement techniques.

General Conditions:

1. The standards and calibration program of the AFPSL, as operated by The Bionetics Corporation, Newark Metrology Operations, complies with the requirements of the current version of ISO/IEC 17025 on the date of calibration.
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Calibrated By:

Michael Harmon **Metrology Technician**



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Approved By:

Curtis A. Brissette **Metrology Technician**



Phone: (740) 788-5451

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Report Number: 130630070
Date of Issue: 20130305
Model/Part No.: 451P SERIES
Serial Number: 0000004400

Procedures and Equipment Used

PROCEDURES

Procedure
33K7-4-93-1

Date
30 Nov 2003

EQUIPMENT

Nomenclature
CESIUM-137 STANDARD

Model/Part No.
81-10

ID No.
P71064

NIST Report No.
N/A

Cal Due Date
20141004

The reported value(s) and uncertainties resulting from the measurement process are:

Report of Measurement

Range mR/hr	Applied mR/hr	T.I. Reading mR/hr
0 - 0.5	0.4	0.400
0 - 5	1.0	1.02
0 - 5	4.0	3.85
0 - 50	10.0	10.1
0 - 50	40.0	39.0
0 - 500	100	100
0 - 500	400	389
R/hr	R/hr	R/hr
0 - 5	1.0	0.98
0 - 5	4.0	4.05

- The instrument calibration results are accurate to within $\pm 10\%$ of reading between 10 and 100% full scale on any range, exclusive of energy response.



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AIR FORCE PRIMARY STANDARDS LABORATORY

CERTIFICATE OF CALIBRATION

Report Number: 131440029

Department: Photonics/Nucleonics

Date of Issue: 20130626

Calibration Item:

Manufacturer: INOVISION

Model/Part No.: 451P SERIES

Equipment Type: ION CHAMBER SURVEY METER

Equipment Submitted by:

88 MSG/LGRMD

5060 PEARSON ROAD

WRIGHT PATTERSON AFB, OH, 45433-5517

Serial Number: 0000006573

ID Number: F264806

Item Condition:

As Received: UNKNOWN or Not applicable
The item was not calibrated by the PMEL and/or the calibration condition as received can NOT be determined.

As Returned: IN-TOLERANCE

Item was calibrated and returned in-tolerance. This includes TO directed limitations.

Room Ambient Conditions:

Temperature: 73 °F

Relative Humidity: 45 %

Barometric Pressure: N/A

Remarks:

Traceability: Measurement standards and test equipment used are traceable to the International System of Units (SI) through the National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facilities; or to other National Metrology Institutes (NMI); or have been derived from accepted values of natural physical constants; or mutual consent standards; or have been derived by the ratio or reciprocity type measurement techniques.

General Conditions:

1. The standards and calibration program of the AFPSL, as operated by The Bionetics Corporation, Newark Metrology Operations, complies with the requirements of the current version of ISO/IEC 17025 on the date of calibration.
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Calibrated By:

Michael Harmon Metrology Technician



Approved By:

Donald M. Hayes Lead Metrology Technician



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TEL: (740) 788-5400

FAX: (740) 788-5404

Report Number: 131440029
Date of Issue: 20130626
Model/Part No.: 451P SERIES
Serial Number: 0000006573

Procedures and Equipment Used

PROCEDURES

Procedure
33K7-4-93-1

Date
30 Nov 2003

EQUIPMENT

Nomenclature
CESIUM-137 STANDARD

Model/Part No.
81-10

ID No.
P71063

NIST Report No.
N/A

Cal Due Date
20151010

The reported value(s) and uncertainties resulting from the measurement process are:

Report of Measurement

Range mR/hr	Applied mR/hr	T.I. Reading mR/hr
0 - 0.5	0.4	0.403
0 - 5	1.0	0.99
0 - 5	4.0	4.02
0 - 50	10.0	10.1
0 - 50	40.0	39.7
0 - 500	100	101
0 - 500	400	397
R/hr	R/hr	R/hr
0 - 5	1.0	0.98
0 - 5	4.0	3.97

- The instrument calibration results are accurate to within $\pm 10\%$ of reading between 10 and 100% full scale on any range, exclusive of energy response.



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**THE BIONETICS CORPORATION
NEWARK METROLOGY OPERATIONS**

SERVICE REPORT

Report Number: 131440029

Department:
Photonics/Nucleonics

Date of Issue: 20130626

Calibration Item:

Manufacturer: Inovision
Model/Part No.: 451P SERIES
Equipment Type: Ion Chamber Survey Meter
Serial Number: 0000006573
ID Number: F264806

Equipment Submitted by:

88 MSG/LGRMD
5060 PEARSON ROAD
WRIGHT PATTERSON AFB, OH, 45433-5517

Repair Report Section:

Problem Stated by Customer: None

Evaluation: The second range was reading erratically. When applying 1 mR/hr the meter would spike up 3 mR/hr causing the calibration program to reset its readings.

Work Performed: Sent for contract repair and calibrated IAW TO 33K7-4-93-1

Adjustment Report Section:

As Received Data: N/A

As Returned Data: N/A

Work Performed By:

Michael Harmon Metrology Technician



Phone: (740) 788-5451



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